AD-A135 283 BASIC AND APPLIED RESEARCH IN THE FIELD OF ELECTRONICS AND COMMUNICATIONS(U) MASSACHUSETTS INST OF TECH CAMBRIDGE RESEARCH LAB OF ELECTRON.. J ALLEN NOV 83 1/1

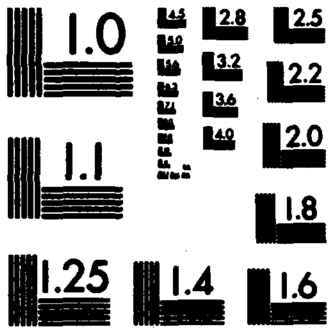
UNCLASSIFIED ARO-17209.59-EL DAAG29-80-C-0104 F/G 9/3 NL

END

FILMED

1-84

DTIC


1.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6

ARO 17209.59-EL

(12)

AD-A135 283

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

RESEARCH LABORATORY OF ELECTRONICS

CAMBRIDGE, MASS. 02139

Rm. 36-419

November 17, 1983

OSP 89350

Department of the Army
U. S. Army Research Office
P. O. Box 12211
Research Triangle Park
North Carolina 27709

Attn: Richard D. Ulsh
Chief, Information Processing Office
DRXRO-IP P-17209-EL

Dear Mr. Ulsh:

In accordance with the terms of the Research Agreement No. DAAG 29-80-C-0104, we are sending you the following material:

Type of material:	Final Report
Title:	Basic and Applied Research in the Field of Electronics and Communications
Submitted by:	J. Allen
Peirod covered:	1 June 1980 - 31 October 1982
No. of copies:	Fifty

Jonathan Allen
Director,
Research Lab. of Electronics

cc: Publications Office (1)
R. L. Van De Pitte

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A135	3. RECIPIENT'S CATALOG NUMBER 283
4. TITLE (and Subtitle) BASIC AND APPLIED RESEARCH IN THE FIELD OF ELECTRONICS AND COMMUNICATIONS		5. TYPE OF REPORT & PERIOD COVERED Final Report 1 June 1980 - 31 Oct. 1982
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Jonathan Allen		8. CONTRACT OR GRANT NUMBER(s) DAAG 29-80-C-0104
9. PERFORMING ORGANIZATION NAME AND ADDRESS Research Laboratory of Electronics Massachusetts Institute of Technology Cambridge, MA 02139		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS P-17209-EL
11. CONTROLLING OFFICE NAME AND ADDRESS U. S. Army Research Office Post Office Box 12211 Research Triangle Park, NC 27709		12. REPORT DATE November 1983
		13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlim'ted.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

The view, opinions, and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other documentation.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Atomic physics	Electronics	Molecular physics
Communications	Lasers	Quantum electronics
Electromagnetics	Microwaves	Signal processing

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Results of the research done under this contract are described in the articles or presented at the meetings enumerated in the attached List of Publications.

PROGRESS REPORT

(TWENTY COPIES REQUIRED)

1. ARO PROPOSAL NUMBER: ______________________

2. PERIOD COVERED BY REPORT: 1 June 1980 - 31 October 1982

3. TITLE OF PROPOSAL: Basic and Applied Research in the Field of Electronics and Communications

4. CONTRACT OR GRANT NUMBER: DAAG 29-80-C-0104

5. NAME OF INSTITUTION: Massachusetts Institute of Technology

6. AUTHOR(S) OF REPORT: Jonathan Allen

7. LIST OF MANUSCRIPTS SUBMITTED OR PUBLISHED UNDER ARO SPONSORSHIP DURING THIS PERIOD, INCLUDING JOURNAL REFERENCES:

8. SCIENTIFIC PERSONNEL SUPPORTED BY THIS PROJECT AND DEGREES AWARDED DURING THIS REPORTING PERIOD:

Accession For	
NTIS GRA&I	☒
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	

ARO Form 129
18 Sep 75

BASIC AND APPLIED RESEARCH IN THE FIELD OF ELECTRONICS AND COMMUNICATIONS

FINAL TECHNICAL REPORT

Submitted by

Jonathan Allen

June 1, 1980 to November 1, 1982

U.S. Army Research Office

contract DAAG29-80-C-0104

Research Laboratory of Electronics

Massachusetts Institute of Technology

Cambridge, Massachusetts 02139

TABLE OF CONTENTS

REPORT ON RESEARCH

This report summarizes research accomplishments for the period June 1, 1980 through October 31, 1982. The Joint Services Electronics Program at MIT brings together faculty in Electrical Engineering, Physics and Chemistry to work on fundamental electronics-related processes. Research is organised in seven work units entitled Picosecond Optics, Chemical Dynamics, Surface Physics and Phase Transitions, Applied Optics, Atomic and Molecular Physics, Submicrometer Artificial Microstructures and Applications, and Electromagnetics.

During this contract period, research in Picosecond Optics continued to be a major thrust area. Modelocking of semiconductor lasers has been demonstrated as well as passive ways of producing trains of picosecond pulses by modulating a CW optical source with an external modulator driven at microwave frequencies. A theory of noise of free electron lasers has also been developed during this period since such phenomena were found to play an important role in the modelocking of semiconductor lasers. During this period, a new facility for picosecond and subpicosecond diagnostics was built up. A femtosecond laser system is now operational and has been applied to several different femtosecond dynamic studies. For example, picosecond studies of carrier dynamics in quaternary semiconductors, such as InGaAsP have also been started. The ability to use pulses in this regime to investigate a wide variety of transient phenomena is being exploited throughout the Laboratory in a variety of JSEP supported projects.

Work in the semiconductor surfaces group continues at a very strong level, involving participation by both theorists and experimentalists within the Physics Department as well as participation from the Chemistry Department. Basic work on the fundamental properties of surface and interface electronic excitations has been carried out in a way that provides a complete quantum mechanical description of the elementary excitations of the various systems studied. Under JSEP sponsorship, the development of theoretical understanding for total energy calculations as well as phase transitions in chemisorbed systems has produced very strong results that are naturally complementary to our extensive experimental investigations.

In the experimental surface area, high resolution X-ray scattering has been used to model surface systems, smectic liquid crystals, and intercalant materials. This research has revealed a broad variety of new phenomena including structures which are solid in one directions and fluid in the other. The combined theoretical and experimental thrust of this work is leading to a careful atomic level understanding of practical surface and interface systems.

The Atomic Physics program is a basic research effort aimed at understanding atomic and molecular processes. A particular focus has been the study of the interaction of highly excited atoms with radiation. In this connection Rydberg Atoms have been characterized in a variety of environments, including the development of Rydberg Atom millimeter wave radiation detectors, of considerable practical significance. Techniques

were even developed to inhibit spontaneous emission from these atoms, providing new insights. Work also continues in this field on atom field interactions leading to the creation of time frequency standards, as well as the exceedingly accurate measurement of fundamental constants.

A particularly strong focus of the JSEP program continues to be the Submicron Structures Laboratory which was established under JSEP support. An incredible variety of submicron structures have been developed through the utilization of X-ray techniques. Creating patterns with periods below 1000 A have been demonstrated as well as fundamental contributions to reactive ion etching and holographic lithography. Studies in this area have also included investigations of MOS channel conduction, the growth of graphoepitaxial monocrystalline films, and the confirmation of a model for the enhanced Ramon effect based on the excitation of plasmon resonances in silver particles on a submicron grid. In addition to providing a wide variety of important results, this laboratory is also a major resource for the provision of structures used by many investigators within the JSEP program.

Finally, two projects focus on electromagnetic phenomena. These have included the study of propagation through a variety of media involving many diverse geometries and nonlinear effects. We have also been studying propagation through magnetostatic structures, including sophisticated control of the propagation modes in order to yield appropriate dispersion characteristics.

In addition to the studies already described, new activity under the heading of chemical dynamics is building up. Apparatus for the utilization of molecular beams directed at semiconductor surfaces in order to measure reaction products is underway, and we expect that this facility will provide fundamental understanding of such practical processes as reactive ion etching.

The fundamental studies carried out under the JSEP program at MIT continue to exhibit novel and sometimes startling results which are being incorporated into current theories, together with practical knowledge appropriate for the fabrication of high performance electronic systems. We continue to retain this emphasis and direct these results to the enhancement of contemporary integrated circuit processes.

PUBLICATIONS ACKNOWLEDGING JOINT SERVICES SUPPORT

Published, Accepted for Publication, or Submitted

June 1, 1980 to November 1, 1982

Contract No. DAAG29-80-C-0104

Papers Published

S. Akiba, G.E. Williams, and H.A. Haus, "High Rate Pulse Generation from InGaAsP Laser in Selfoc Lens External Resonator," Electron. Lett. 17:15, 527-529 (1981).

S.M. Ali, C. Chew, and J.A. Kong, "Vector Hankel Transform Analysis of Anular-Ring Microstrip Antenna," IEEE Trans. Vol AP-30, No. 4, 637-644, July 1982.

S.M. Ali, T.M. Habashy, and J.A. Kong, "Resonance in Two Coupled Circular Microstrip Disk Resonators," J. Appl. Phys. 53:9, 6418-6429 (1982).

J. Als-Nielsen, J.D. Litster, R.J. Birgeneau, M. Kaplan, C.R. Safinya, A. Lindegaar-Andersen, and S. Mathiesen, "Observation of Algebraic Decay of Positional Order in a Smectic Liquid Crystal," Phys. Rev. B. 22, 312-330 (1980).

KA. Bezjian, H.I. Smith, J.M. Carter and M.W. Geis, "An Etch Pit Technique for Analysing Crystallographic Orientation in Si Films," J. Electrochem. Soc. 129, 1848 (1982).

R.J. Birgeneau, G.S. Brown, P.M. Horn, D.E. Moncton, and P.W. Stephens, "Synchrotron X-ray Study of Monolayer Krypton Melting," J. Phys. C 14, L49-L54 (1981).

R.J. Birgeneau, E.M. Hammonds, P. Heiney, P.W. Stephens, and P.M. Horn, "Structure and Transitions of Monolayer Krypton and Xenon on Graphite," in S.K. Sihha (Ed.), Ordering in Two Dimensions (Elsevier North Holland, Amsterdam, The Netherlands, 1980), pp.29-38.

F.J. Birgeneau, C.W. Garland, G.B. Kastig and B.M. Ocko, "Critical Behavior Near the Nematic-Smectic A Transition in Butoxybenzylidene Octylaniline (40.8)," Phys. Rev. A 24, 2624 (1981).

R.J. Birgeneau, P.A. Heiney, G.S. Brown, P.M. Horn, D.E. Moncton, and P.W. Stephens, "The Freezing Transition of Monolayer Xenon on Graphite," Phys. Rev. Lett. 48:2, 104-108 (1982).

R.J. Birgeneau, P.A. Heiney, and J.P.Peltz, "High Resolution X-Ray Studies of Monolayer Krypton on Varied Forms of Graphite," Phys. 109 and 110B, 1785-1795 (1982).

R.G. Caflisch and A.N. Berker, "Oxygen Chemisorbed on Ni(100): Renormalization-Group Study of the Global Phase Diagram," Phys. Rev. B.

J.K. Carney and C.G. Fonstad, "Segmented Contact GaAs/GaAlAs DH Laser Diodes," Proceedings of the 1980 International Symposium on Gallium Arsenide and Related Compounds, Inst. Phys. Conf. Ser. No. 56, pp.319-328 (1980).

J.K. Carney and C.G. Fonstad, "Double-Heterojunction Laser Diodes with Multiple Segmented Contacts," Appl.Phys. Lett. 38:5, 303-305 (1981).

N.M. Ceglio, G.F. Stone and A.M. Hawryluk, "Microstructures for High Energy X-Ray and Particle Imaging Applications," J.Vac.Sci. Tech. 19, Nov/Dec. 1981, p.886.

W.C. Chew and J.A. Kong, "Resonance of the Axial-Symmetric Mode in Microstrip Disk Resonators," J. Math. Phys. 21, 582-591 (1980).

W.C. Chew, J.A. Kong, and L.C. Shen, "Radiation Characteristics of a Circular Microstrip Antenna," J.Appl. Phys. 51, 3907-3915 (1980).

W.C. Chew and J.A. Kong, "Resonance of Nonaxial Symmetric Modes in Circular Microstrip Disk Antenna," J. Appl. Phys. 21, 2590-2598 (1980).

W.C. Chew and J.A. Kong, "Analysis of Circular Microstrip Disk Antenna with Thick Dielectric Substrate, "IEEE Trans. Vol AP-29, No. 1 68-76, January 1981.

W.C. Chew and J.A. Kong, "Asymptotic Formula for the Resonant Frequencies of a Circular Microstrip Antenna." J. Appl. Phys. 52:8, 5365-5369 (1981).

W.C. Chew and J.A. Kong, "Electromagnetic Field of a Dipole on a Two-Layer Earth," Geophysics 46, 309-315 (1981).

W.C. Chew and J.A. Kong, "Asymptotic Formula for the Capacitance of Two Oppositely Charged Discs," Math.Proc.Camb.Philos. Soc. 89, 373-384 (1981).

W.C. Chew and J.A. Kong, "Asymptotic Eigenequations and Analytic Formulas for the Dispersion Characteristics of Open, Wide Microstrip Lines," IEEE Trans. Vol. MTT-29, 933-941, September 1981.

W.C. Chew and J.A. Kong, "Microstrip Capacitance for a Circular Disk Through Matched Asymptotic Expansions," J.Appl. Mathematics 42:2, 301-317 (1982).

W.C. Chew and J.A. Kong, "Asymptotic Approximation of Waves Due to a Dipole on a Two-Layer Medium," Radio Sci. 17:3, 509-513 (1982).

W.C. Chew, "A Broadband Anular-Ring Microstrip Antenna," IEEE Trans. Vol. AP-30, No. 5, 918-922, September 1982.

R.S. Chu and J.A. Kong, "Diffraction of Optical Beams with Arbitrary Profiles by a Periodically-Modulated Layer," J. Opt. Am. 70, 1-6 (1980).

S.L. Chuang, L.Tsang, J.A. Kong, and W.C. Chew, "The Equivalence of the Electric and Magnetic Surface Currents Approaches in Microstrip Antenna Studies," IEEE Trans. Vol. AP-28, No. 4, 569-571, July 1980.

J. Collett, L.B. Sorensen, P.S. Pershan, J.D. Litster, R.J. Birgeneau and J. Als-Nielsen, "Synchrotron X-ray Study of Novel Crystalline-B Phases in 70.7," Phys. Rev. Lett. 49,553 (1982).

J. Collett, L.B. Sorensen, P.s. Pershan, J.D. Litster, R.J. Birgeneau, and J. Als-Nielsen, "Synchrotron X-ray Study of Novel Crystalline-B Phases in Heptyloxybenzylidene-Heptylaniline (70.70," Phs. Rev. Lett. 49, 553 (1982).

D.E. Cooper, and J.D. Litster, "Molecular Orientation Dynamics in Gels and Critical Mixtures," in Picosecond Phenomena II, (eds. R.M. Hochstrasser, W. Kaiser, and C.V. Shank) Springer, Berlin 1980, p. 115.

J.L. Davis and S. Ezekiel, "Closed-Loop, Low-Noise Fiber-Optic Rotation Sensor," Optics Lett. 6:10, 505-507 (19810.

N.N. Efremow, N.P. Economou, K. Bezjian, S.S. Dana, and H.I. Smith, "A Simple Technique for Modifying the Profile of Resist Exposed by Holographic Lithography," J.Vac. Sci. Technol. 19:4, 1234-1237 (19810.

S. Ezekiel, J.L. Davis, and R.W. Hellwarth, "Observation of Intensity-Induced Nonreciprocity in Fiberoptic Gyroscope," Optics Lett. 7:9, 457-459 (1982).

S. Ezekiel and H.J. Arditty, "Fundamentals of Fiberoptic Rotations Sensors," in Fiberoptic Rotation Sensors, (eds. S. Ezekiel and H.J. Arditty), Springer-Verlag, 1982.

S. Ezekiel, J.L. Davis and R. Hellwarth, "Intensity Dependent Nonreciprocal Phase Shift in Fiber Gyros," in Fiberoptic Rotation Sensors (Eds. S. Ezekiel and H.J. Arditty), Springer-Verlag, 1982.

A. Ezzedine, J.A. Kong, and L. Tsang, "Transient Field of a Vertical Electric Dipole Over a Two-Layer Nondispersive Dielectric," J. Appl. Phys. 52:3, 1202-1208 (1981).

A. Ezzedine, J.A. Kong, and L. Tsang, "Time Response of a Vertical Electric Dipole Over a Two-Layer Medium by the Double Deformation Technique," J. Appl. Phys. 53:2, 813-822 (1982).

C.M. Gee and M. Kastner, "Intrinsic Defect Photoluminescence in Amorphous and Crystalline SiO_2," J. Non-Cryst. Solids 35/36, 927-932 (1980).

C.M. Gee and M. Kastner, "Intrinsic-Defect Photoluminescence from E Band Centers in Amorphous and Crystalline SiO_2," J. Non-Cryst. Solids 40, 577-586 (1980).

L.A. Glasser, "A Linearized Theory for the Diode Laser in an External Cavity," IEEE Trans. Vol. QE-16, No. 5, pp. 525-531, May 1980.

R.P. Hackel, L.A. Hackel, and S. Ezekiel, "Re-Evaluation of the Hyperfine Coupling Constants for B-X Transitions in I_2, 1342-1343 (1980).

E.M. Hammond, P.Heiney, P.W. Stephens, R.J. Birgeneau, and P. Horn, "Structure of Liquid and Solid Monolayer Xenon on Graphite," J. Phys. C 13, L301-L306 (1980).

H.A. Haus, "Theory of Modelocking of Laser Diode in External Resonator," J.Appl.Phys. 51, 4042-4049 (1980).

H.A. Haus, "Modelocking of Semiconductor Laser Diodes," Japanese J. Appl. Phys. 20:6 (1981).

H.A. Haus, S.T. Kirsch, K.Mathyssek, and F.J. Leonberger, "Picosecond Optical Sampling," IEEE Trans. Vol. QE-16, No. 8, 870-874, August 1980.

H.A. Haus, "Models of Modelocking of a Laser Diode in an External Resonator," IEEE Proc. Vol. 127, Part I, No. 6, 323-329, December 1980.

H.A. Haus, "Mode-Locked Semiconductor Diode Lasers," Phyl.Trans.R. Soc.Lond. 298A, 257-266 (1980).

H.A. Haus, "Noise in Free-Electron Laser Amplifier," IEEE J. Vol. QE-17, No. 8, 1427-1435, August 1981.

A.M. Hawryluk, N.M. Ceglio, R.H. Price, J. Melngailis, and H. I. Smith, "Gold Transmission Gratings with Submicrometer Periods and Thicknesses >0.5μm[a)]," J. Vac. Sci. Technol. 19:4, 897-900 (1981).

A.M. Hawryluk, H.I. Smith, R.M. Osgood, and D.J. Ehrlich, "Deep-Ultraviolet Spatial-Period Division Using an Excimer Laser," Optics Lett. 79, 402-404 (1982).

A.M. Hawryluk and H.I. Smith, "Comment on New Model of Electron Free Path in Multiple Layers for Monte Carlo Simulation," J. Appl. Phys. 53, 5985 (1982).

P.R. Hemmer, F.Y. Wu, and S. Ezekiel, "Influence of Atomic Recoil on Power Broadened Lineshapes," Opt. Commun. 38:2, 105-109 (1981).

P.R. Hemmer, B.W. Peuse, F.Y. Wu, J.E. Thomas, and S. Ezekiel, "Precision Atomic-Beam Studies of Atom-Field Interactions," Optics Lett. 6:11, 531-533 (1981).

C.M.Horwitz, "Reactive Sputter Etching of Silicon with Very Low Mask-Material Etch Rates," IEEE Trans. Vol. ED-28, No. 11, 1320-1323, November 1981.

C.M.Horwitz and J. Melngailis, "Reactive Sputter Etching of Si, SiO_2, Cr, Al, and Other Materials with Gas Mixtures Based on CF_4 and Cl_2[a]," J. Vac.Sci. Technol. 19:4, 1408-1411 (1981).

J. Ihm and J.D. Joannopoulos, "Ground State Properties of GaAs and AlAs," Phys. Rev. B 24:8, 4191-4197 (1981).

J. Ihm and J.D. Joannopoulos, "Structural Energies of Al Deposited on the GaAs(110) Surface," Phys. Rev. Lett. 47:9, 679-682 (1981).

J. Ihm and J.D. Joannopoulos, "Structure of the Al-GaAs(110) Interface from an Energy-Minimization Approach," Phys. Rev. B. 26:8, 4429-4435 (1982).

J. Ihm and J.D. Joannopoulos, "First-Principles Determination of the Structure of the Al/GaAs(110) Surface," J. Vac. Sci. Technol. 21:2, 340-343 (1982).

E.P. Ippen, D.J. Eilenberger, R.W. Dixon "Picosecond Pulse Generation Diode Lasers," pp.21-25 Picosecond Phenomena II, Springer Series in Chemical Physics Vol. 14, R.M. Hochstrasser et al. Eds. Springer Verlag 1980.

M. Kardar, "Phase Boundaries of the Isotopic Helical Potts Model on a Square Lattice," Phys. Rev. B. 26:5, 2693-2699 (1982).

A.R. Kortan, H.V. Kanel, R.J. Birgeneau and J.D. Litster, "High Resolution X-ray Scattering Study of the Nematic-Smectic A-Re-entrant Nematic Transitions in 8OCB/6OCB Mixtures," Phys. Rev. Lett. 47, 1206, (1981).

A.R. Kortan, A. Erbil, R.J. Birgeneau, and M.S. Dresselhaus, "Commensurate-Incommensurate Transition in Bromine-Intercalated Graphite: A Model Stripe-Domain System," Phys. Rev. Lett. 49:19, 1427-1430 (1982).

D. Kleppner, "Inhibited Spontaneous Emissions," Phys. Rev. Lett. 47:4, 233-236 (1981).

J.H. Lang and D.H. Staelin, "Electrostatically-Figured Reflecting Membrane Antennas for Satellites," IEEE Trans. Vol. AC-27, No. 3, 666-670, June 1982.

J.H. Lang and D.H. Staelin, "The Computer-Controlled Stabilization of a Noisy Two-Dimensional Hyperbolic System," IEEE Trans. Vol. AC-27, No. 5, pp. 1033-1043, October 1982.

D.H.Lee and J.D. Joannopoulos, "Surface States at Unrelaxes ZnO (1010)," J.Vac.Sci.Technol. 17, 987-988 (1980).

D.H. Lee and J.D. Joannopoulos, "Simple Scheme for Surface Band Calculations I.," Phys. Rev. 23:10, 4988-4996 (1981).

D.H. Lee and J.D. Joannopoulos, "Simple Scheme for Surface Band Calculations II. The Green's Function," Phys. Rev. 23:10, 4997-5004 (1981).

D.H. Lee and J.D. Joannopoulos, "A New Theory of Surface Excitations," J. Vac. Sci. Technol. 19:3, 355-359 (1981).

D.H. Lee and J.D. Joannopoulos, "A Renormalization Scheme for the Transfer Matrix Method and the Surfaces of Wurtzite ZnO, Phys. Rev. B 24, 6899 (1981).

D.H. Lee and J.D. Joannopoulos, "Simple Scheme for Deriving Atomic Force Constants: Application to SIC," Phys. Rev. Lett. 48:26,1846-1849 (1982).

D.H. Lee and J.D. Joannopoulos, "Ideal and Relaxed Surface of SiC," J. Vac. Sci. Technol. 21:2, 351-357 (1982).

P.F. Liao, J.G. Bergman, D.S. Chemla, A. Wokaun, J. Melngailis, A.M. Hawryluk and N.P. Economous, "Surface Enhanced Raman Scattering from Microlithographic Silver Particle Surfaces," Chem. Phys. Lett. 82(2), 355 (1981).

J.D. Litster, C.W. Garland, K.J. Lushington, and R. Schaetzina, "Experimental Studies of Liquid Crystal Phase Transitions," Mol. Cryst. and Liq. Cryst. 63, 145 (1981).

D.E. Moncton, P.W. Stephens, R.J. Birgeneau, P.M. Horn, and G.S. Brown, "Synchrotron X-Ray Study of the Commensurate-Incommensurate Transition of Monolayer Krypton on Graphite," Phys, Rev. Lett. 46:23, 1533-1536 (1981).

F.R. Morgenthaler, "Novel Devices Based upon Field Gradient Control of Magnetostatic Modes and Waves," FERRITES: Proc. of the International Conference, Sept.-Oct., 1980, Japan.

F.R. Morgenthaler, "Magnetostatic Surface Modes in Nonuniform Thin Films with In-plane Bias Fields," J. of Appl. Physics, 52:3, Part II, 2267-2269, November, 1980.

F.R. Morgenthaler, "Synthesis of Magnetostatic Waves and Modes Using Nonuniform Bias Fields," 1980 Ultrasonics Symposium Proc. 1, 532-536, November 1980.

F.R. Morgenthaler, "Nondispersive Magnetostatic Forward Volume Waves Under Field Gradient Control," J. Appl Phys. 53:3, (March, 1982).

F.R. Morgenthaler and T. Bhattacharjee, "Numerical Solution of the Integral Equations of MSSW," in IEEE Trans. on Magnetics, MAG-18:6, November 1982.

B.W. Peuse, M.G. Prentiss, and S. Ezekiel, "Distortion in Atomic Beam Absorption Lineshapes, "J. dePhysique-Colloque C8:12, tome 42, C8-53-C8-57, December 1981.

B.W. Peuse, M.G. Prentiss, and S. Ezekiel, "Observation of Resonant Light Diffraction by an Atomic Beam," Phys. Rev. Lett. 49:4, 269-272 (1982).

S.Y. Poh, W.C. Chew, and J.A. Kong, "Approximate Formulas for Line Capacitance and Characteristics Impedance of Microstrip Line," IEEE Trans. Vol. MTT-29, No. 2, 135-142, February 1981.

S.Y. Poh, W.C. Chew, and J.A. Kong, "Approximate Formulas for Line Capacitance and Characteristic Impedance of Microstrip Line ," IEEE Trans. Vol. MTT-29, No. 2 135-142 (1981).

D.R. Ponikvar and S. Ezekiel, "Stabilized Single-Frequency Stimulated Brillouin Fiber Ring Laser," Optics Lett. 6:8, 398-400 (1981).

M.G. Prentiss, J.L. Davis and S. Ezekiel, "Closed Loop, High Sensitivity Fiber Gyroscope," in Fiberoptic Rotation Sensors (eds. S. Ezekiel and H. J. Arditty), Springer-Verlag, 1982.

S.R. Rotman, C.B. Roxlo, D. Bebelaar, and M.M.Salour, "Pulsewidth Stabilization of a Synchronously Pumped Mode-Locked Dye Laser," Appl.Phys.Lett. 36, 886-888 (1980).

S.R. Rotman, C. Roxlo, D. Bebelaar, T.K. Yee, and M.M. Salour, "Generation, Stabilization and Amplification of Subpicosecond Pulses," Appl. Phys. B 28, 319-326 (1982).

C.R. Safinya, M.Kaplan, J.Als-Nielsen, R.J. Birgeneau, D. Davidov, J.D. Litster, D.L. Johnson, and M.E. Neubert, "High Resolution X-Ray Study of Smectic A-Smectic C Phase Transition," Phys. Rev. B. 21, 4149-4153 (1980).

C.R. Safinya, R.J. Birgeneau, J.D. Litster, and M.E. Neubert, "Critical Fluctuations Near a Nematic-Smectic A-Smectic C Multicritical Point," Phys Rev. Lett. 47:9, 668-671 (1981).

W.P. Spencer, A.G. Vaidyanathan, D. Kleppner, and T.W. Ducas, "Temperature Dependence of Blackbody Radiation Induced Transfer Among Highly Excited States of Sodium," Phys. Rev A 25:1, 380-384 (1982).

W.P. Spencer, A.G. Vaidyanathan, D. Kleppner, and T.W. Ducas, "Measurements of Lifetimes of Sodium States in a Cooled Environment," Phys. Rev. A 24:5, 2513-2517 (1981).

W.P. Spencer, A.G. Vaidyanathan, D. Kleppner, and T.W. Ducas, "Photoionization by Blackbody Radiation," Phys. Rev. A 26:3, 1490-1493 (1982).

D.D. Stancil, "Magnetostatic Waves in Nonuniform Bias Fields Including Exchange Effects," IEEE Trans. Vol. MAG-16, No. 5, 1153-1155, September 1980.

D.D. Stancil and F.R. Morgenthaler, "The Effects of Nonuniform Inplane Fields on the Propagation Characteristics of Magnetostatic Surface Waves," 1980 IEEE Ultrasonics Symposium Proc. 1, November 1980.

P.W. Stephens, P.A. Heiney, R.J. Birgeneau, P.M. Horn, J. Stoltenberg, and O.E. Vilches, "X-Ray and Heat-Capacity Study of Molecular Oxygen Absorbed on Graphite," Phys. Rev. Lett. 45, 1959-1962 (1980).

R.E. Tench, B.W. Peuse, P.R. Hemmer, J.E. Thomas, S. Ezekiel, C.C. Leiby, Jr., R.H. Picard, and C.R. Willis, "Two Laser Raman Difference Technique Applied to High Precision Spectroscopy," J. dePhysique-Colloque C8:12, tome 42, pp.C8-45 - C8-51, December 1981.

P. Terry and M.W.P. Strandberg, "Induced Molecular Transport Due to Surface Acoustic Waves," J. Appl. Phys. 52:6, 4281-4287 (1981).

J.E. Thomas, S. Ezekiel, C.C. Leiby, Jr., R.H.Picard and C.R. Willis, "Ultrahigh Resolution Spectroscopy and Frequency Standards in the Microwave and Far-Infrared Regions Using Optical Lasers," Optics Lett. 6:6, 298-300 (1981).

L. Tsang and J.A. Kong, "Energy Conservation for Reflectivity and Transmissivity at a Very Rough Surface," J. Appl. Phys. 51, 681-690 (1980).

L. Tsang, and J.A. Kong, "Multiple Scattering of Electromagnetic Waves by Random Distributions of Discrete Scatterers with Coherent Potential and Quantum Mechanical Formulism," J. Appl. Phys. 51, 3465-3485 (1980).

L. Tsang and J.A. Kong, "Multiple Scattering of Acoustic Waves by Random Distribution of Discrete Scatterers with the Use of Quasicrystalline-Coherent Potential Approximation," J. Appl. Phys. 52:9, 5448-5458 (1981).

N. Tsumita, J. Melngailis, A.M. Hawryluk, and H.I. Smith, "Fabrication of X-Ray Masks Using Anisotropic Etching of (110) SI and Shadowing Techniques," J. Vac. Sci. Technol. 19:4, 1211-1213 (1981).

A.G. Vaidyanathan, W.P. Spencer, and D. Kleppner, "Inhibited Absorption of Blackbody Radiation," Phys. Rev. Lett. 47:22, 1592-1595 (1981).

H. von Kanel and J.D. Litster, "Light Scattering Studies on Single-Layer Smectic p-Butoxybensilidene p-Octylaniline," Phs. Rev. A 23, 3251 (1981).

H. von Kanel, J.D. Litster, J. Melngailis and H.I. Smith, "Alignment of Nematic Butoxybensilidene Octylaniline by Surface Relief Gratings," Phys. Rev. A., 24, 2713 (1981).

Y-M. Wang and J.D. Joannopoulos, "The Ga Core Exciton at Unrelaxed GaAs (110)," J. Vac. Sci. Technol. 17, 997-1000 (1980).

J.S. Walker, "Exact Preservation of the Free Energy in a Modified Midgal-Kadanoff Approximation," Phys. Rev. B 26:7. 3792-3796 (1982).

J.M. Wiesenfeld, L.F. Mollenauer, and E.P. Ippen, "Ultrafast Configurational Relaxation of Optically Excited Color Centers," Phys. Rev. Lett. 47 1668-1671, 1981.

M. Zuniga, J.A. Kong, and L. Tsang, "Depolarization Effects in the Active Remote Sensing of Random Media," J.Appl. Phys. 51, 2315-2325 (1980).

M. Zuniga and J.A. Kong, "Modified Radiative Transfer Theory for a Two-Layer Random Medium," J. Appl. Phys. 51, 5228-5244 (1980).

Meeting Papers Presented

1980 International IEEE AP-S Symposium, USNC URSI Meeting, Universite Laval, Quebec, Canada
June 2-6, 1980

Abstracts in Proceedings

W.C. Chew and J.A. Kong, Input Impedance and Radiation Characteristics of a circular Microstrip Antenna (p. 190)

W.C. Chew and J.A. Kong, Resonance of Axial and Non-Axial Symmetric Modes in Circular Microstrip Disk Antenna (Vol. II, pp. 621-625)

S.L. Chuang, J.A. Kong, and L. Tsang, Radiative Transfer Theory for a Two-Layer Random Medium with Cylindrical Structure (p. 258)

T.M. Habashy, J.A. Kong, and W.C. Chew, Electromagnetic Fields of a Dipole Submerged in a Two-Layer Conducting Medium in the ELF Regime (p. 150)

M. Kubacsi and R. Shin, Radiative Transfer Theory for Active Remote Sensing of Homogeneous Layer Containing Ellipsoidal Scatterers (p. 261)

M.E. McGillan, Radiative Transfer Theory Applied to Remote Sensing of Homogeneous Media Containing Discrete Scatterers (p. 253)

R. Shin, J.A. Kong, and L. Tsang, Radiative Transfer-Theory for Active and Passive Microwave Remote Sensing of Homogeneous Layer Containing Spherical Scatterers (p. 260)

D. H. Staelin and J. H. Lang, Electrostatically-Controlled Antennas (p. 354)

M.A. Zuniga and J.A. Kong, Modified Radiative Transfer Theory for a Two Layer Random Medium (p. 263)

M.A. Zuniga, S.L. Chuang, J.A. Kong, and J.K. Lee, Active Microwave Remote Sensing of an Anisotropic Two-Layer Random Medium (p. 262)

International Topical Conference on the Physics of MOS Insulator, North Carolina State University, Raleigh, North Carolina
June 18-20, 1980

Papers in Proceedings

C. M. Gee and M. Kastner, Time Decay of Photoluminescence from Amorphous SiO_2 (pp.132-136)

XI International Quantum Electronics Conference, Boston, Mass.
June 23-26, 1980

J. Thomas, Direct Observation of Diamagnetic in CO_2 10.6 Band Zeeman Spectra Using a Stabilized Twin Laser Spectrometer

The 3rd International Conference on Ferrites, Kyoto, Japan
September 29 - October 2, 1980

Papers in Summaries

F.R. Morgenthaler, Novel Devices Based Upon Field Gradient Control of Magnetostatic Modes and Waves (pp. 220-221)

International Conference on Microlithography, Amsterdam
September 30-October 2, 1980

Papers in Proceedings

H.I. Smith, The Impact of Submicrometer Structures in Research and Applications

19th IEEE Conference on Decision and Control, Albuquerque, New Mexico
December 10-12, 1980

Papers in Proceedings

J.H. Lang, A Perturbation Analysis of Spillover in Closed-Loop Distributed-Parameter Systems (pp.750-754)

J.H. Lang and D.H. Staelin, Electrostatically-Controlled Large-Aperture Reflecting Satellite Antennas (pp. 991-993)

Symposium uber Microstruckturforschung, Institut fur Hableitertechnik, Aachen, Federal Republic of Germany
March 5-6, 1981

H.I. Smith, Submicrometer Structures Technology

Workshop on the Interaction of Laser Radiation with Surfaces for Application to Microelectronics, MIT, Cambridge, Massachusetts
May 4-5, 1981

H.I. Smith, Review of Conventional Submicrometer Fabrication Techniques

16th Symposium on Electron, Ion, and Photon Beam Technology, Dallas, Texas
May 26-29, 1981

N.N. Efremow, N.P. Economou, K. Bezjian, S.S. Dana, and

H.I. Smith, A Simple Technique for Modifying the Profile of Resist Exposed by Holographic Lithography

A.M. Hawryluck, N.M. Ceglio, R.H. Price, J. Melngailis, and H.I. Smith, Gold Transmission Gratings with Submicrometer and Thicknesses >0.5μm

C.M. Horwitz and J. Melngailis, Reactive Sputter Etching and Si, SiO_2, Cr, and Al with Gas Mixtures Based on CF_4, Cl_2, and $CiCl_4$

N. Tsumita, J. Melngailis, A.M. Hawryluck, and H.I.Smith, Fabrication of X-ray Masks Using Anisotropic Etching of (110) Si and Shadowing Techniques

Topical Conference on Low Energy X-ray Diagnostics, Monterey, California
June 8-10, 1981

Papers in Proceedings
H.I. Smith, Fabrication of Diffractive Optical Elements for X-ray Diagnostics

1981 International Geosciences and Remote Sensing Symposium. Washington, D.C.
June 8-10, 1981

Abstracts in Digest
M.A. Zuniga and J.A. Kong, Mean Dyadic Green's Function for Remote Sensing of a Two Layer Random Medium (Vol. I, pp. 691-695)

1981 International IEEE MTT-S and AP-S Symposium and National Radio Science Meeting, Los Angeles, California
June 15-19, 1981

W.C. Chew and J.A. Kong, Asymptotic Eigenequations for the Dispersion Characteristics of Open, Wide Microstrip Line

Fifth International Conference on Laser Spectroscopy, Alberta, Canada
June 29-July 3, 1981

Papers in A.R. W. McKeller, T. Oka, and B.P. Stoicheff (Eds) Laser Spectroscopy V (Springer-Verlag, Berlin, New York, 1981)

D. Kleppner, Turning Off the Vacuum (pp.292-293)

B.W. Peuse, R.E. Tench, P.R. Hemmer, J.E. Thomas, and S. Ezekiel, Precision Studies in 3-Level Systems (pp. 251-254)

Fifth International Conference on Vapor and Epitaxy and Fifth American Conference on Crystal Growth, Coronado, California
July 19-24, 1981

S.S. Dana and H.I. Smith, Studies fo Graphoepitaxy by CVD and Solution Growth

AIAA Guidance and Control Conference, Albuquerque, New Mexico
August 19-21, 1981

Papers in Proceedings

J.H. Lang, Experiments on the Electrostatic Control of a Flexible Membrane and Their Relation to Membrane-Antenna Figure Control (pp.187-191)

Workshop on All-Optical Processing Elements in Integrated Optics, London, England
September 17-18, 1981

H.A. Haus and A. Lattes, Optical Logic Gates and Possible Applications

Thirteenth Annual Meeting of the Division of Electron and Atomic Physics, American Physical Society, New York, New York
December 3-5, 1981

Abstracts in Bull.Am.Phys. Soc. 26:9 (1981)

D. Kleppner, A.G. Vaidyanathan, and W.P. Spencer, Turnoff of Blackbody Absorption (p.1317)

Tropical Meeting on Integrated and Guided-Wave Optics, Asilomar Conference Center, Pacific Grove, California
January 6-8, 1982

Papers in Technical Digest

H.A. Haus, Picosecond Sampling in Optical Waveguides (paper WA1-1-WA1-4)

A. Lattes, C. Gabriel, and H.A. Haus, Doubly Degenerate Four-Wave Mixing in Optical Waveguide (paper ThA4-1 - ThA4-3)

1982 Meeting, American Physical Society, Dallas, Texas
March 8-12, 1982

Abstracts in Bull.Am.Phys.Soc. 27:3 (1982)

A.R. Kortan, High Resolution X-ray Study of Reentrant Nematic 60 CB-80 CB Mixtures (p.366)

R.F. Kwasnick, M.A. Kastner, and J. Melngailis, Electronic Conduction in Ultra-Narrow Silicon Inversion Layers

Fifth Topical Meeting on Optical Fiber Communication and 1982 Conference on Lasers and Electro Optics, Phoenix, Arizona
April 13-16, 1982

H.A. Haus, High Speed Optical Waveguide Switching

A.M. Hawryluk, H.I. Smith, R.M. Osgood, and D.J. Ehrilch, Spatial-Period-Division Using and ArF Laser

XII International Quantum Electronics Conference, Munich, Germany
June 22-25, 1982

H.A. Haus, A. Lattes, E.P.Ippen, and F.J. Leonberger, Optical Exclusive OR Gate

H.A. Haus, A. Lattes, C. Gabriel, E.P. Ippen and F.J. Leonberger, Doubly Degenerate Four-Wave Mixing in $LiNbO_3$ Waveguides

1982 March Meeting, American Physical Society, Dallas, Texas
March 8-12, 1982

Abstracts in Bull.Am.Phys. Soc. 27 (1982)
A.N.Berker, Commensurate-Incommensurate Phase Diagrams From the Helical Potts Model (invited paper) (p.140)

NATO Advanced Research Institute Microelectronics, Les des Alpes, France
March 15-19, 1982

H.I. Smith, New Approaches to Single-Crystal Thin Films for Devices and Systems Using Surface Patterns

NATO Workshop on Target Background Modelling Techniques at Millimeter Wavelengths, Harry Diamond Laboratories, Adelphi, Maryland
May 11-12, 1982

J.A. Kong, Active and Passive Remote Sensing of Earth Terrain at Millimeter Wavelength

47th Statistical Mechanics Meeting, Rutgers University, New Brunswick, New Jersey
May 13-14, 1982

M. Kardar, Phase Boundaries of the Isotropic Helical Potts Model on the Square Lattice

Thesis Acknowledging Joint Services Support

June 1, 1980 to November 1, 1982

J.K. Carney, "Non-Uniform Current Injection in GaAs/GaAlAs Diode Lasers," Ph.D. Thesis, Department of Electrical Engineering and Computer Science, October, 1980.

J.G. Fujimoto, "Construction and Application of a Synchronous Streak Camera System," M.S. and E.E. Thesis, Department of Electrical Engineering and Computer Science, May, 1981.

J.L. David, "Inertial Rotation Sensing Using a Fiber Sagnac Interferometer," Ph.D. Thesis, Department of Electrical Engineering and Computer Science, September, 1981.

P.A. Heiney, "Phase Transitions of 2D Atomic and Molecular Cyrstals," Ph.D. Thesis, Physics Department, March, 1982.

R.E. Meyer, "Study of Observed Spatial Variations in the Resonant Frequency of an Optical Resonator," B.S. and M.S. Theses, Physics Department, February, 1982.

W.P. Spencer, "Radiative Processes Among Rydberg Atoms," Ph.D. Thesis, Physics Department, January, 1982.

A.G. Vaidyanathan, "Far Infra-Red and Microwave Studies of Rydberg Atoms," Ph.D. Thesis, Physics Department, June, 1982.

A.L. Lattes, "Ultrafast Nonlinear Effects in Optical Waveguides," Ph.D. Thesis, Physics Department, November, 1982

Lislie Itano, "Microwave Delay Line with Thin Film Antenna," S.M. Thesis Department of Electrical Engineering and Computer Science, September, 1981.

Daniel Fishman, "Investigation of the Velocity of Energy Circulation of Magnetostatic Modes in YIG," S.M. Thesis, Department of Electrical Engineering and Computer Science, September, 1981.

Daniel Stancil, "Effects of Nonuniform Fields on Magnetostatic Waves in Ferrite Thin Films," Ph.D. Thesis, Department of Electrical Engineering and Computer Science, September, 1981.

Alan Wadsworth, "Improvements in the Design of Microwave Magnetoelastic Delay Lines," S.M. Thesis, Department of Electrical Engineering, January, 1982.

PERSONNEL SUPPORTED BY THE JOINT SERVICES ELECTRONICS PROGRAM

Faculty

Antoniadis, Dimitri A.

Berker, Ahmet N.

Birgeneau, Robert J.

Ceyer, Sylvia

Ezekiel, Shaoul

Fonstad, Clifton G.

Haus, Hermann A.

Ippen, Erich P.

Joannopoulos, John

Kastner, Marc

Kleppner, Daniel

Kong, Jin-Au

Lee, Patrick

Litster, J. David

McFeely, F. Reed

Morgenthaler, Frederic R.

Nelson, Keith

Pritchard, David

Salour, Michael M.

Smith, Henry I.

Staelin, David H.

Staley, Ralph H.

Principal Research Scientist

Melngailis, John

Research Staff

Barrows, Francis H.

Bhattacharjee, Tushar

Cepko, Constance

Coleman, John W.

Horwitz, Christopher

Kumar, Prem

Kupferberg, Lenn

Lee, Dung-Hai

Saenger, Katherine

Shao, Michael

Spencer, William

Walker, James

Zeskind, Dale

Zimmerman, Myron

Research Assistants

Andleman, David
Bezkjian, Krikor A.
Carney, James
Chawla, Gunjit
Chou, Yu
Chuang, Shun-Lien
David, J. L.
Fujimoto, James
Gee, Caroline
Ghavamishahidi, Ghavam
Gibson, Dwight
Habashy, Terek
Heiney, Paul
Hemmer, Philip
Hulet, Randall
Jan, Darrell
Johnson, Richard
Kappes, Manfred
Kardar, Mehran
Kirsch, Steven
Kuznetsov, Mark
Kwasnick, Robert
Larson, Brent
Lattes, Ana
Lee, Myung
McClellan, Michael
Meyer, Raymond
Migdall, Alan
Mochrie, Simon
Monroe, Donald
Peuse, Bruce
Robinson, Margaret
Safinya, Cyruls
Sanders, Glen
Schadler, Edward
Sezginer, Abdurrahman
Shih, Shih-Ming
Shinn, Neal David
Simonson, Robert
Solomon, Lorraine
Spencer, William
Stathis, James
Stein, Josephine
Stix, Michael
Stone, Alfred
Tang, Sau Lan
Tench, Robert
Towe, Elias
Trenary, Michael
Urbaniuk, Walter A.
Vaidyanathan, Akhileswar
Vlannes, Nickolas P.
Warren, Alan
Whitaker, Norman
Yam, Yeung

END

FILMED

1-84

DTIC